

Snowmass Muon Collider Forum

April 14, 2021

Accelerator Frontier: Derun Li (LBNL), and Diktys Stratakis (Fermilab)

Energy Frontier: Kevin Black (Univ. of Wisconsin-Madison), and Sergo Jindariani (Fermilab)

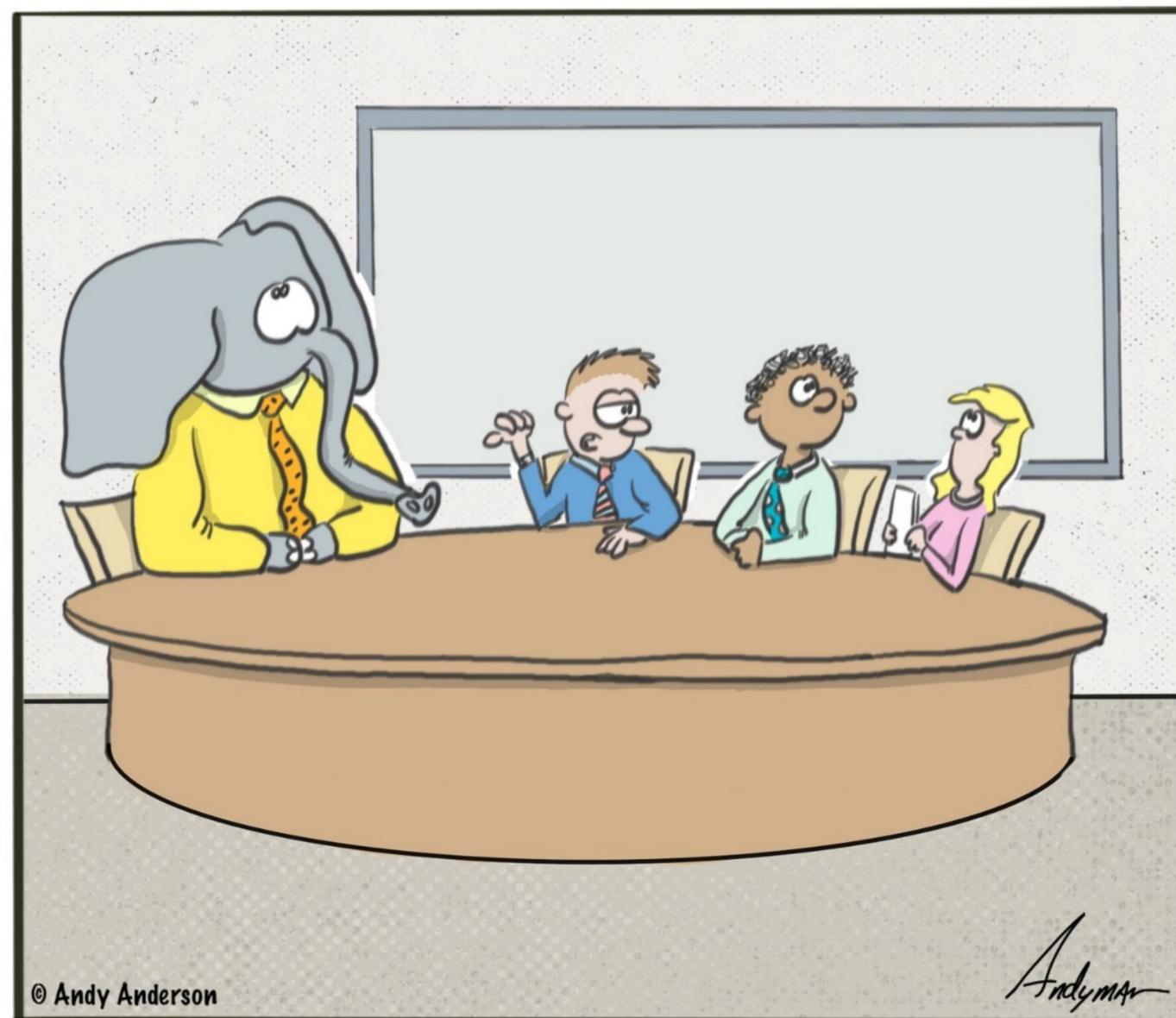
Theory Frontier: Fabio Maltoni (Louvain U., CP3) and **Patrick Meade** (Stony Brook - YITP)

Announcements/Agenda/News

What's new since our kickoff meeting on Jan 27?

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SO WE'RE NOT GOING TO DISCUSS IT?

Announcements/Agenda/News

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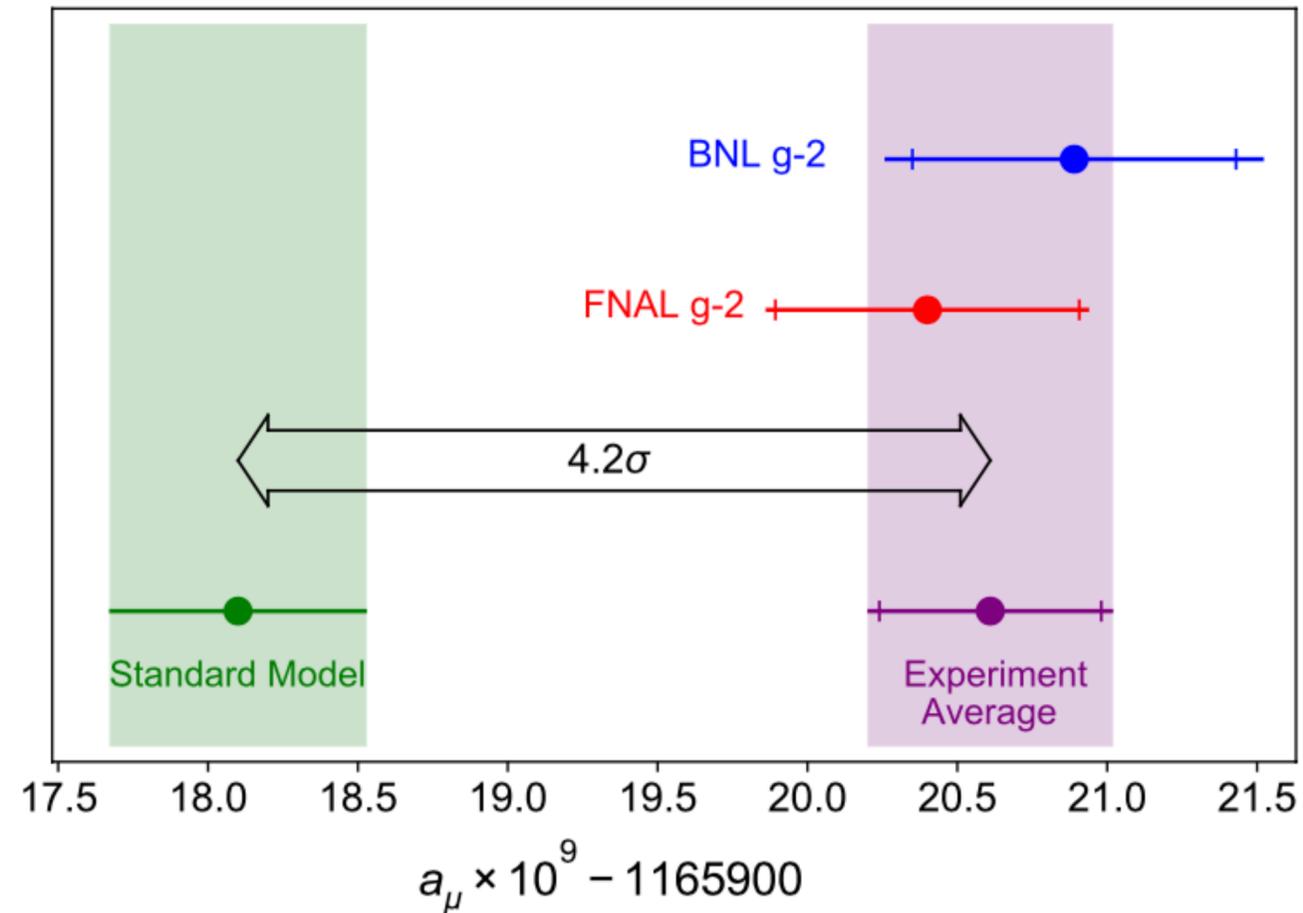


FIG. 4. From top to bottom: Experimental values of a_μ from BNL E821, this measurement, and the combined average. The inner tick marks indicate the statistical contribution to the total uncertainties. The Muon $g - 2$ Theory Initiative recommended value [13] for the Standard Model is also shown.

Resonances

Thursday, 8 April 2021

Why is it when something happens it is ALWAYS you, muons?

April 7, 2021 was like a good TV episode: high-speed action, plot twists, and a cliffhanger ending. We now **know** that the strength of the little magnet inside the muon is described by the g-factor:

$$g = 2.00233184122(82).$$



Lots of interesting muon related anomalies lately

We'll have to see what happens, but certainly **none** of them *point away* from a muon collider.. and *if* confirmed by theory/exp *muon colliders could be favored* uniquely, for example:

A Guaranteed Discovery at Future Muon Colliders

[Rodolfo Capdevilla \(Toronto U. and Perimeter Inst. Theor. Phys.\)](#), [David Curtin \(Toronto U.\)](#), [Yonatan Kahn \(Illinois U., Urbana\)](#),
[Gordan Krnjaic \(Fermilab\)](#)
Jun 29, 2020

Probing the muon $g-2$ anomaly at a Muon Collider

[Dario Buttazzo \(INFN, Pisa\)](#), [Paride Paradisi \(Padua U. and INFN, Padua\)](#) (Dec 4, 2020)
e-Print: [2012.02769](#) [hep-ph]

A No-Lose Theorem for Discovering the New Physics of $(g - 2)_\mu$ at Muon Colliders

[Rodolfo Capdevilla \(Toronto U. and Perimeter Inst. Theor. Phys.\)](#), [David Curtin \(Toronto U.\)](#), [Yonatan Kahn \(Illinois U., Urbana, Astron. Dept.\)](#), [Gordan Krnjaic \(Fermilab and Chicago U., KICP\)](#)
Jan 25, 2021

What else is new?

Muon Collider News from the EF

- **Upcoming major workshops and events:**
 - Muon Collider mini-symposium during the APS April Meeting (4 sessions: B08, D14, H08, Y07).
Trying to make recordings available to those who are not registered for the APS meeting
 - Muon Collider Physics and Detector workshop in June (organized outside Snowmass, dates to be announced soon)
 - Snowmass activities in the slowdown mode, expect restart in July, workshops in the Fall
- **Muon Collider Full simulation framework:**
 - New version released: v02-06-MC → infnprd/mucoll-ilc-framework:1.5-centos8 (March 2021)
 - “Frozen” detector geometry, tracking and jet performance shown to be very good (with BIB!), work on PF reconstruction is ongoing.
 - Welcome ideas/help with reconstruction and alternative detector ideas
- **Analyses with FullSim and Delphes**
 - We are aware of several ongoing physics studies (Higgs couplings, HH, VBS, etc)
 - If you are currently doing a Muon Collider analysis or plan to start one soon, please let us know. We can help with generating samples and getting started with the code
 - Preparing a Twiki page with useful pointers, will be circulated on the Slack channel and the mailing list

Muon Collider News from the AF

- **Upcoming workshops and events:**
 - See presentation from EF
- **Recent activities:**
 - Virtual workshop on Muon Collider Testing opportunities. Aimed to explore ideas and opportunities for system testing, and for proposing new test facilities and test beams. Talks can be found at <https://indico.cern.ch/event/1016248/>
 - Brainstorming meetings held for defining accelerator parameters and technologies needed towards a 10 TeV muon collider. Preliminary study results for a Fermilab version MC will be presented at this meeting (see Katsuya's talk)
 - Formation of a muon panel to address R&D needs on a Muon Collider as part of the European Accelerator R&D Road Map. One of the goals is to specify a series of concrete deliverables, including demonstrators over the next decade by seeking input from community meetings. Three meetings to be planned this year. More news can be found: <https://muoncollider.web.cern.ch/>

Muon collider news from TF

Steady increase in number of theory studies on arXiv, since January for example:

Gauged $L_\mu - L_\tau$ at a muon collider

[Guo-yuan Huang](#) (MPG, Germany), [Farinaldo S. Queiroz](#) (Federal University of Rio Grande do Norte), [Werner Rodejohann](#) (MPG, Germany) (Jan 13, 2021)

e-Print: [2101.04956](#) [hep-ph]

Searching for Leptoquarks at Future Muon Colliders

[Pouya Asadi](#), [Rodolfo Capdevilla](#), [Cari Cesarotti](#), [Samuel Homiller](#) (Apr 12, 2021)

e-Print: [2104.05720](#) [hep-ph]

Probing electroweak phase transition with multi-TeV muon colliders and gravitational waves

[Wei Liu](#) (Nanjing U.), [Ke-Pan Xie](#) (Seoul Natl. U.) (Jan 25, 2021)

Published in: *JHEP* 04 (2021) 015 • e-Print: [2101.10469](#) [hep-ph]

Higgs and BSM Physics at the future Muon Collider

[Roberto Franceschini](#), [Mario Greco](#) (Apr 12, 2021)

e-Print: [2104.05770](#) [hep-ph]

Hunting wino and higgsino dark matter at the muon collider with disappearing tracks

[Rodolfo Capdevilla](#) (Toronto U. and [Perimeter Inst. Theor. Phys.](#)), [Federico Meloni](#) (DESY), [Rosa Simoniello](#) (CERN), [Jose Zurita](#) (Valencia U.) (Feb 22, 2021)

e-Print: [2102.11292](#) [hep-ph]

The Muon Smasher's Guide

[Hind Al Ali](#) (UC, Santa Barbara), [Nima Arkani-Hamed](#) (Princeton, Inst. Advanced Study), [Ian Banta](#) (UC, Santa Barbara), [Sean Benevedes](#) (UC, Santa Barbara), [Dario Buttazzo](#) (INFN, Pisa) et al. (Mar 25, 2021)

e-Print: [2103.14043](#) [hep-ph]

Finally today...

Goal: to facilitate a sharing of ideas across a wider community

Today “we” decided to do this by focusing a bit:

- Lot of theory studies at **many** different energies (ranging up to 100 TeV at this time)
- Is there potentially an interesting energy where it's not outside our future light cone design wise, budget wise, **and** has a strong physics case?
- How does it fit with muon collider collaboration, are there potential US versions?
- We suggested O(10) TeV to speakers, but nothing set in stone! However, in the course of Snowmass it would be useful to have some convergence so maybe this is a step in that facilitation direction...

Finally today...

11:10 AM

→ 11:40 AM

Physics at high energy Muon Collider

Speakers: Tim Cohen (University of Oregon), Tim Cohen (University of Oregon)

11:40 AM

→ 12:00 PM

High Energy Muon Collider - technology needs

Speaker: Katsuya Yonehara (Fermilab)



MCforumKYApr202...

12:00 PM

→ 12:20 PM

Status and Plans from Muon Collider Collaboration (TBC)

Speaker: Daniel Schulte (CERN)

12:20 PM

→ 1:00 PM

Discussion

Potential Discussion Questions

- Is 10 TeV possible from the AF frontier perspective? What's the best case energy if one were to consolidate on one (in "our" time)? Staging? International vs US differences? What's the most optimistic timeline from a purely technical point of view?
- What's the ideal luminosity goals for physics cases?
- How much effort should be put into polarization? Energy/Lumi tradeoffs?
- For EF physics goals, what should definitely be a baseline goal for detector design? Increased acceptance? Better tracking (displaced)? Higgs vs BSM tradeoffs?
- MuC obviously goes together with Neutrino Frontier - Consolidating on a design we need more cross-collaboration there, neutrino factory, but also high E uses?